CLAIMS

1. Apparatus for limiting current in an electrical circuit element, comprising:

a circuit element operating in response to a bias current fed thereto for generating an output voltage signal across the circuit element;

a first circuit connected to one end of the circuit element for applying a bias current of a desired value to the circuit element in response to the value to an input signal;

a second circuit connected to the other end of the circuit element for setting the amplitude of the output voltage signal generated across the circuit element in response to the bias current; and,

a third electrical circuit connected to both the first and second circuits for limiting the value of bias current to a predetermined level in response to an abnormal current condition of the circuit element.

2. The apparatus according to claim 1 wherein the circuit element comprises a magneto-resistive circuit element.

3. The apparatus according to claim 2 wherein the abnormal current condition comprises a short circuit condition of the magneto-resistive circuit element.

4. The apparatus according to claim 3 wherein the magneto-resistive element forms part of a read head for a hard disk drive and wherein the output voltage generated across the circuit element comprises a differential voltage.

5. Apparatus for limiting current in a magneto-resistive circuit element, comprising:

a circuit element operating in response to a bias current fed thereto for generating an output voltage signal across the circuit element;

a first circuit connected to one end of the circuit element for applying a bias current of a desired value to the circuit element in response to the value to an input signal;

a second circuit connected to the other end of the circuit element for setting the amplitude of the output voltage signal generated across the circuit element in response to the bias current; and,

a third electrical circuit connected to both the first and second circuits for limiting the value of bias current to a predetermined level in response to a short circuit condition of the magneto-resistive circuit element.

6. The apparatus according to claim 5, wherein said first and second electrical circuits includes a respective first and second current control device, each having a pair of current conducting terminals and a control terminal for controlling conduction between the conducting terminals,

said pair of current conducting terminals of said first current control devices being connected between one side of said circuit element and a first bias voltage supply source,

said pair of current conducting terminals of the other of said current control devices being connected between the other side of said circuit element and a second bias voltage supply source,

a first signal amplifier circuit responsive to an input signal for applying an output signal to the control terminals of the first current control device,

a second signal amplifier circuit responsive to a signal corresponding to the bias current for applying an output signal to the control terminal of said second current control device, so as to provide a current balance in said first and second current control devices during normal or non-shorted operation, and,

wherein said third electrical circuit includes a third and fourth current control device, each having a pair of current conducting terminals and a current control terminal, said pairs of current conducting terminals of the third and fourth current control devices being connected in a cascode circuit connection between said first and second bias voltage supply sources, the current control terminal of the third current control device being connected with the output signal of the first signal amplifier also applied to the control terminal of the first current control device, and,

a third signal amplifier circuit responsive to a signal corresponding to a current flowing between the third and fourth current control devices for applying an output signal to the control terminal of the second current device along with the output signal of the second signal amplifier for clamping the control terminal of the second current control to a voltage corresponding to the output signal of the third signal amplifier in the event a short circuit condition occurs in said circuit element.

7. The apparatus according to claim 6 and additionally including a first resistive impedance connected between one of the current conducting terminals of the first current control device and the first bias

voltage supply source, a second resistive impedance connected between one of the current conducting terminals of the second current control device and the second bias voltage supply source, third resistive impedance connected between one of the current conducting terminals of the third current control device and the first bias voltage supply source, and a fourth resistive impedance connected between the current conducting terminals of the third and fourth current control devices, wherein the value of the fourth resistive impedance is greater than the value of the second resistive impedance and where an input of the third signal amplifier is connected to one side of the fourth resistive element.

8. The apparatus according to claim 7 wherein the value of the first resistive impedance is substantially equal to the value of the third resistive impedance.

9. The apparatus according to claim 8 and additionally including a pair of series connected resistive impedances connected across the magneto-resistor element and having an intermediate connection connected to an input of the second signal amplifier.

10. The apparatus according to claim 9 wherein the magneto-resistive circuit element forms part of read head for a hard disk drive.

11. The apparatus according to claim 9 wherein the current control devices comprise semiconductor devices.

12. The apparatus according to claim 11 wherein said semiconductor devices comprise transistors.

13. The apparatus according to claim 11 wherein the first and second current control devices comprise transistors of mutually opposite type semiconductor material.

14. The apparatus according to claim 11 wherein the third and fourth current control devices comprise transistors of mutually opposite type semiconductor material.

15. The apparatus according to claim 14 wherein the first and third transistors comprise transistors of a first type semiconductor material and second and fourth transistors comprise transistors of a second type semiconductor material.

16. The apparatus according to claim 9 wherein the first signal amplifier circuit includes an amplifier having a first polarity input terminal connected to the input signal and a second polarity input terminal connected to an output terminal thereof through the first current control device.

17. The apparatus according to claim 9 wherein the second signal amplifier circuit includes an amplifier having a first polarity input terminal connected to a signal corresponding to the bias voltage and a second polarity input terminal connected to a point of reference potential or ground.

18. The apparatus according to claim 9 wherein the third signal amplifier circuit includes an amplifier having a first polarity input terminal connected to the signal corresponding to the current flowing between the third and fourth current control devices and a second polarity input terminal directly connected to an output terminal thereof.

19. The apparatus according to claim 4 wherein the first, second and third electrical circuits are implemented in an integrated circuit.

20. The apparatus according to claim 5 wherein the first, second and third electrical circuits are fabricated in an integrated circuit structure.